I. Project Title: **Monitoring the Colorado Pikeminnow Population in the Mainstem Colorado River via Periodic Population Estimates**

II. Principal Investigator(s):

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III. Project Summary:

The Interagency Standardized Monitoring Program (ISMP) was developed in 1986 to monitor population trends of Colorado pikeminnow and humpback chub in the Colorado River Basin using catch per effort (CPE) indices. ISMP was expanded in 1998 to include mark-recapture population estimates of the major Colorado pikeminnow and humpback chub populations. For Colorado pikeminnow in the upper Colorado River, population estimates were conducted annually during 1991-1994 and 1998-2000. A third, three-year field effort begun in 2003 was completed in 2005. For this recent round of estimates, annual effort was expanded in hopes of producing estimates with smaller standard errors.

In the first year, 2003, four complete passes were made through the 185-mile reach (excluding 12-mile-long Westwater Canyon) using a combination of electrofishing and backwater trammel-netting. In addition to more passes, effort per pass was also increased from one 2-person crew to two 2-person crews. This schedule was completed during a 12-week period from early April to mid-June. Although the field effort went very well, the number of Colorado pikeminnow captured was low relative to previous years. The number of fish marked in the first passes that were subsequently recaptured in later passes was especially low. This low recapture rate resulted in Model M_o from Program CAPTURE (White et al. 1982) providing a relatively high point estimate of 784 individuals 450 mm TL and longer (95% CI: 350-1,940). However, this result was in contrast to the catch rate, measured as mean-number-of-Colorado-pikeminnow-per-net-set, that was lower than in any year since 1991. For the population estimate, the probability of capture (p-hat) was very low ($p = 0.03$), and the coefficient of variation was unacceptably high (CV= 47%).

In 2004, the same high level of effort was applied per pass as during 2003, i.e., two 2-person boat crews in the upper reach (above Westwater Canyon) working concurrently with

two 2-person boat crews in the lower reach (downstream of Westwater Canyon). However, in 2004, the spring hydrograph was short-lived and although work began (first week of April) well before the start of runoff (first week of May), pikeminnow began moving to spawning locations early (first week of June) and we were forced to curtail sampling after completing only three passes. In addition, runoff was so low that backwaters could not be netted, forcing us to rely exclusively on electrofishing. Again, for whatever reason, our recapture rate in the second and third passes was very low. However, in July, the smallmouth bass removal effort (Project No. 126) in the upper reach began and post-spawning pikeminnow capture data began coming in. Because of a lack of analogous data for the lower reach, this additional sampling could not be turned into a fourth pass for our population estimate. Instead, these upper-reach captures were added to the third pass. This considerably boosted our third-pass recapture rate and allowed a reasonably good population estimate. Model M_o (the null model) and M_t produced similar point estimates of abundance: about 775 individuals $\geq$ 250 mm; about 475 individuals $\geq$ 450 mm; about 370 individuals $\geq$ 500 mm. The 95% confidence interval for pikeminnow $\geq$ 450 mm was 317-789 (Model M_o). The probability of capture (p) improved greatly from the previous year: p-hat = 0.10 (2004); p-hat = 0.03 (2003) for individuals >450 mm. Precision of the estimate was also higher than in 2003. A 'rule of thumb' for acceptable precision is to achieve a coefficient of variation (CV) of 20% or less (Pollock et al. 1990). The CV for our whole-river estimate of Colorado pikeminnow was 47% in 2003 and 24% in 2004.

In 2005, work again began the first week of April. The duration and magnitude of runoff was more normal allowing a fair amount of trammel-netting in addition to the extensive electrofishing effort. Four full passes were completed in the upper reach and five in the lower reach. A fifth pass in the upper reach was provided by captures of pikeminnow during the July smallmouth bass removal project. Results from 2005 are detailed in the discussion of initial findings provided below.

IV. Study Schedule: 2003-2006.

V. Relationship to RIPRAP:
Colorado River Action Plan: Colorado River Mainstem
V. Monitor populations and habitat and conduct research to support recovery actions.
V.A. Conduct research to acquire life history information and enhance scientific techniques required to complete recovery actions.

VI. Accomplishment of FY 05 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Tasks
1. Capture and pittag Colorado pikeminnow (this task was met).
2. Analyze data (Preliminary population estimate calculated).

Four complete sampling passes were made in the upper reach and five in the lower reach using a combination of electrofishing and trammel-netting. As before, 12-mile-long Westwater Canyon was excluded from sampling. This schedule was completed during a 12-week period from early April to mid June. The field effort went well: the extended runoff period in conjunction with a subsequent field effort (smallmouth bass removal) allowed five complete passes. A total of 306 different pikeminnow were captured (all $\geq$ 250 mm), almost double the number caught in either of the two previous years (162 in 2003 and 157 in 2004). There were 48 recaptures in 2005 versus 5 in 2003 and 13 in 2004. Preliminary abundance estimates were produced using Program CAPTURE (White et al. 1982). Model M_o (the null model) and M_t produced similar point estimates of abundance. According to M_o there was an estimated 931 individuals $\geq$ 250 mm; 870 individuals $\geq$ 450 mm; 703 individuals $\geq$ 500 mm. The 95% confidence interval for pikeminnow $\geq$ 450 mm was 684-1151 (Model M_o). The probability of capture (p) was somewhat lower than in 2004 (0.07 in 2005; 0.10 in 2004; 0.03 in 2003) for individuals $\geq$ 450 mm. However, the coefficient of variation (CV), a measure of precision of a point estimate, was better than in previous years (13% in 2005; 24% in 2004; 47% in 2003). A 'rule of thumb' for acceptable precision is to achieve a CV of 20% or less (Pollock et al. 1990). Hence, our level of precision for the 2005 estimate met this goal. Averaging the three annual estimates provided a preliminary estimate of 712 (95% CI = 535-977) fish $\geq$ 450 mm TL for the three-year period.

Relative body condition (*kn*) of Colorado pikeminnow significantly improved since the 1998-2000 period despite an increase in adult abundance. A decrease in mean body condition between 1991-1994 and 1998-2000 led to the suggestion that carrying capacity for Colorado pikeminnow in the upper Colorado River had been reached (Osmundson 1999). This suggestion became a basis for USFWS (2002) to set 700 adults in the Colorado River as one criterion for down-listing the Colorado pikeminnow . If this population continues to increase, future abundance estimates and body condition monitoring will allow more definitive interpretation of the long-term average carrying capacity of the system.

A large cohort became evident in 2003. These fish appeared to be from one year-class, and based on their size, probably were hatched in 1998. In 2003, about half of this cohort fell into the size range that qualified them as subadults about to recruit, i.e., those 400-449 mm long, according to Recovery Goal criteria (USFWS 2002). By 2004, some of these had become larger than 450 mm, while most of the remainder had moved up into the subadult size range. By 2005, most if not all of this group were 450 mm TL or larger (Fig. 1).

Data were too sparse to partition out the subadult-sized fish and develop a separate mark-recapture estimate of their abundance. Therefore, length frequency was used to estimate that 23 captured subadults (400-449 mm) in 2003 represented about 14% of the estimated population of pikeminnow $\geq$250 mm that year, providing an estimate of 203 subadults. In 2004, these calculations resulted in an estimate of 110 subadults. In both cases, the estimates were larger than the number of adults expected to die in each year (118 in 2003 and 72 in 2004), assuming an annual mortality rate of 15% (see

Osmundson et al. 1997). Hence, in 2003 and 2004, eminent recruitment (as measured by the number of subadults) exceeded expected adult mortality. Such accounting lead to anticipated net gains to the adult population. In 2005, only seven of the 306 different fish captured fell between 400 and 449 mm in length, representing about 2.3% of the population, or 21 of the estimated 931 pikeminnow $\geq$ 250 mm. Recruitment of these individuals will be insufficient to balance out the estimated 131 expected to die in 2005 (assuming an annual adult mortality rate of 15% and a population size of 780 adults).

VII. Recommendations: Continue analyzing data and prepare draft and final reports in 2006. Because of the low precision of the 2003 estimate and the big disparity between the seemingly good estimates of 2004 and 2005, it is difficult to read any trend into the three separate annual estimates. Such variability among annual estimates also occurred during the two previous three-year efforts. Averaging annual estimates within each three-year monitoring period may be the most prudent approach to evaluate relatively long-term trends. Doing so suggests that adults of this population have steadily increased in number during the past 13 years. Although still a small population, the trend in abundance remains positive. For future monitoring, I recommend continuing the current schedule of three years of active monitoring followed by a two-year rest period.

VIII. Project Status: On track

IX. FY 05 Budget

A.	Funds Provided:	152,800
B.	Funds Expended:	152,800
C.	Difference:	0
D.	N/A (BR projects)	0
E.	Publication Charges	0

X. Status of Data Submission: Capture data for razorback sucker and bonytail encountered during this project have been submitted to the database manager. Colorado pikeminnow data will be submitted by the end of December.

XI. Signed: *Doug Osmundson*, October 31, 2005.

Literature

Osmundson, D. B., R. J. Ryel, and T. E. Mourning. 1997. Growth and survival of Colorado squawfish in the upper Colorado River. Transactions of the American Fisheries Society 126:687-698.

Osmundson, D. B. 1999. Longitudinal variation in fish community structure and water temperature in the upper Colorado River. Final Report. U. S. Fish and Wildlife Service, Grand Junction, Colorado.

Pollock, K. H., J. D. Nichols, C. Brownie, and J. E. Hines. 1990. Statistical inference for capture-recapture experiments. Wildlife Monographs 107.

White, G. C., D. R. Anderson, K. P. Burnham, and D. L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory, LA-8787-NERP, Los Alamos, New Mexico.

USFWS. 2002. Colorado pikeminnow (Ptychocheilus lucius) Recovery Goals: amendment and supplement to the Colorado Squawfish Recovery Plan. U. S. Fish and Wildlife Service, Denver.

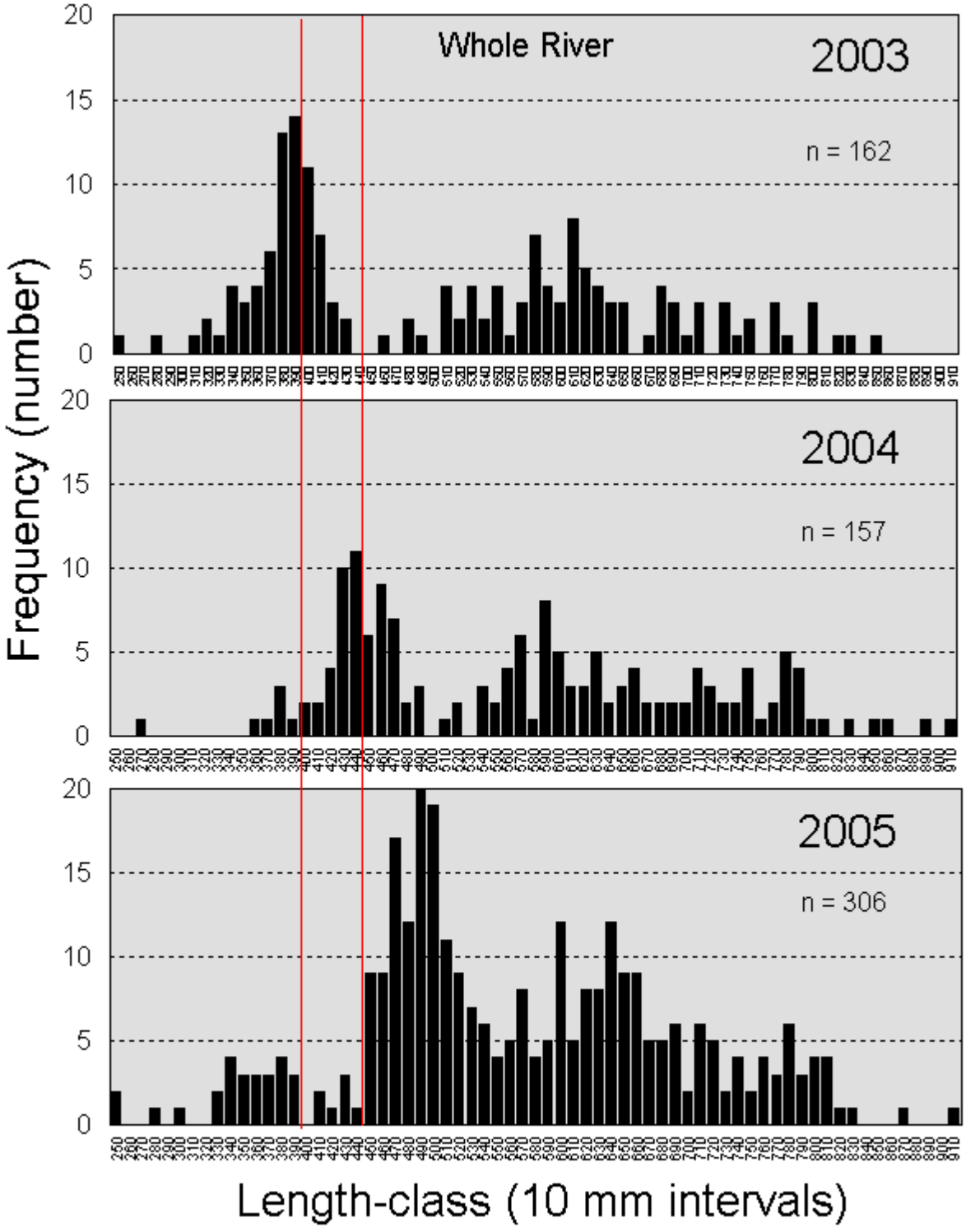

Figure 1. Length frequency of Colorado pikeminnow captured from throughout the upper Colorado River during April-June 2003-2005. Length classes are in 10-mm increments with each labeled with the lower end of the range (example: 350 = those fish 350-359 mm long).